

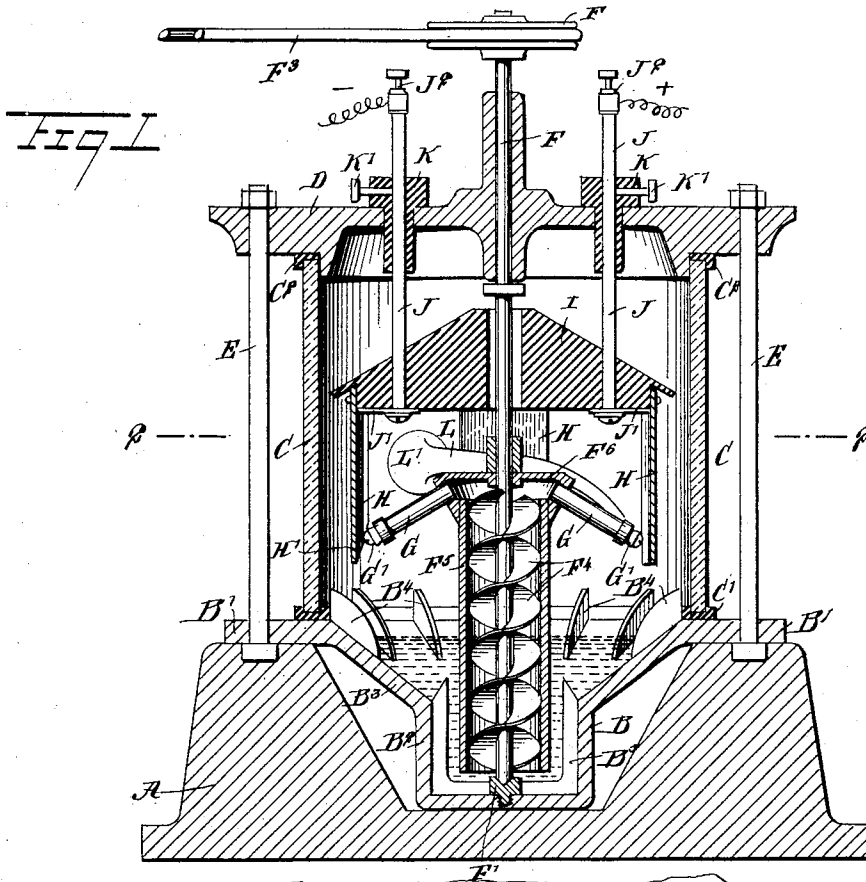
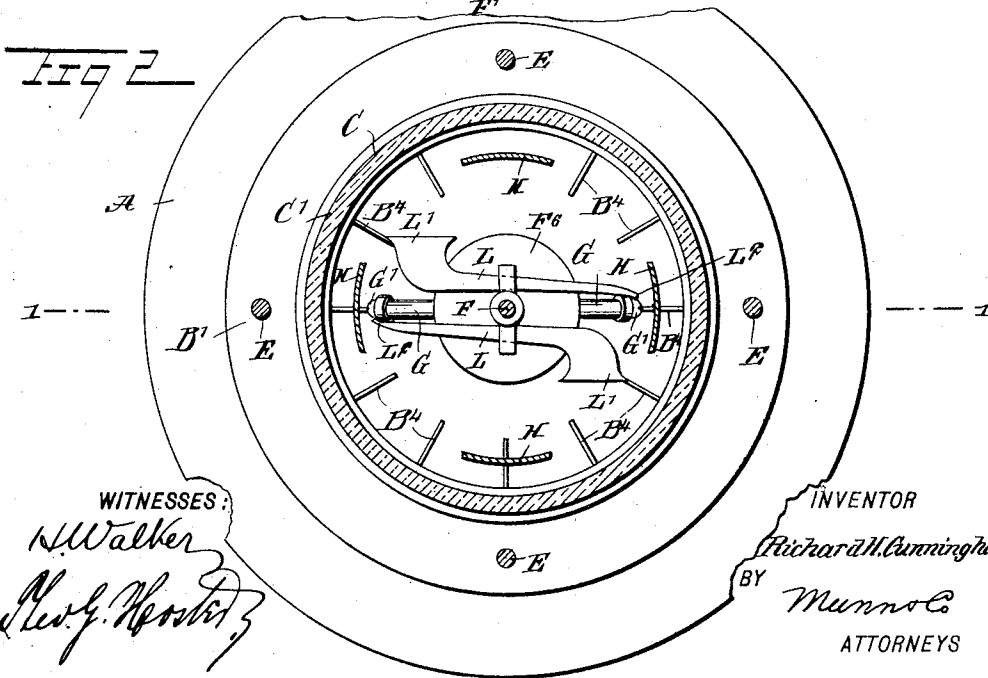
No. 688,068.

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R. H. CUNNINGHAM.
INTERRUPTER.

(Application filed July 10, 1901.)

(No Model.)



WITNESSES:

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INTERRUPTER.

SPECIFICATION forming part of Letters Patent No. 688,068, dated December 3, 1901.

Application filed July 10, 1901. Serial No. 67,723. (No model.)

To all whom it may concern:

Be it known that I, RICHARD HOOPE CUNNINGHAM, a citizen of the United States, and a resident of the city of New York, borough of Manhattan, in the county and State of New York, have invented new and useful Improvements in Interrupters, of which the following is a full, clear, and exact description.

The invention relates to rhythmically-acting induction-coil interrupters, commonly called "mercury-jet" interrupters, in which a continuous jet of mercury serving as one electrode is at regular intervals intersected by a moving row of properly-placed and successively-arranged metallic leaves, which serve as the other electrode.

The object of the invention is to provide a new and improved interrupter for electric induction-coils, electric transformers, and X-ray machines arranged to alternately interrupt and close the electric circuit in a regular and rapid manner, and by which the period per second and the duration of both the makes and breaks are independently controlled within wide limits.

Another object is to provide a device which on breaking an electric circuit, with or without an inductance, minimizes the spark and the effects which ordinarily occur, especially when the electromotive force of the current of self-induction is very high.

A further object of the invention is to provide a reliable interrupting device for induction-coils in general, whereby an undue intensity of current is automatically prevented from traversing the interrupting device in case some unforeseen accident occurs—for instance, when the motive power for actuating the interrupter ceases suddenly.

The invention consists of novel features and parts and combinations of the same, as will be fully described hereinafter and then pointed out in the claims.

A practical embodiment of the invention is represented in the accompanying drawings, forming a part of this specification, in which similar characters of reference indicate corresponding parts in both the views.

Figure 1 is a sectional side elevation of the improvement on the line 1 1 of Fig. 2, and Fig. 2 is a sectional plan view of the same on the line 2 2 of Fig. 1.

On a suitably-constructed base A is secured the annular flange B' of a well B, supporting a gasket C' for the lower edge of the cylindrical body C, of glass or other material, abutting at its upper edge on a gasket C², held on the under side of a cover D, connected by bolts E with the flange B' of the well B, the latter, the body C, and the cover D forming the casing or housing for the interrupter. In a suitable step F' in the bottom of the cylindrical portion B² of the well B is journaled the lower end of the shaft F of a mercury-pump, and the upper end of the said shaft F is journaled in a suitable bearing on the cover D, and on the outer upper end of the said shaft is secured a pulley F², connected by a belt F³ with other machinery for rotating the shaft F and actuating the mercury-pump for the purpose hereinafter more fully described.

On the lower portion of the shaft F are secured one, two, or more spiral blades F⁴, inclosed within a cylinder F⁵, secured to the shaft and extending at its lower open end into the mercury contained in the well B. The upper end of the cylinder F⁵ terminates in a closed head F⁶, from the sides of which extend downwardly and outwardly in opposite directions the jet-pipes G, carrying at their discharge ends discharge-tips G', preferably made of lava or similar suitable material. The mercury pumped from the well B by the mercury-pump into the head F⁶ is discharged through the jet-pipes G and tips G' onto alternately-arranged electrodes H in the shape of metallic plates, each having one lower corner H' cut off obliquely, as indicated at the left in Fig. 1, and said electrodes H are secured at their upper ends on a block I of insulating material, preferably in the shape of a cone and held on insulated rods J, vertically slidable in bushings K of insulating material and secured to the cover D, as is plainly indicated in Fig. 1. Set-screws K' serve to fasten the rods J in position in the bushings K, and by loosening said set-screws the rods J may be raised or lowered, so as to vertically adjust the block I and the electrodes H thereon, and when the desired adjustment has been made the rods are secured in place by screwing up the set-screws K'. The lower ends of the rods J are connected by wires J' with the corresponding electrodes

H, and the outer upper ends of the said rods are provided with suitable binding-posts J², connected with the wires of the circuit. As indicated in the drawings, four electrodes H are employed, of which two are positive electrodes and the other two are negative ones, the positive ones being connected by the wires J' with one of the rods J and the others being connected by the wires J' with the other rod J. The block I, supporting the electrode H, is formed with a central bore, through which passes loosely the shaft F. (See Fig. 1.)

On the top of the head F⁶ of the mercury-pump and rotating with the said head and the shaft F are arranged air-blast devices, preferably in the shape of trumpets L, of which one has its mouth L' located at one side of the shaft F and its discharge end L² terminating close to one of the tips G' on the other side of the shaft, so that when the shaft is rotated air passes into the mouth L' and through the trumpets to finally issue in a fine jet at the corresponding tip G'. The function of the air-blast is to suddenly blow out the spark formed as the mercury separates from the leaves, for at the moment of separation some of the mercury is vaporized, and as the vapor is more conductive than air a spark more or less pronounced in accordance with the intensity of the current occurs. By dissipating this vapor with the air-blast practically as soon as it is formed the spark is blown out and the break becomes instantaneous.

The cylindrical bottom portion B² of the well is connected by an outwardly and upwardly inclined portion B³ with the flange B', and on the inner side of this inclined portion are arranged wings B⁴, disposed radially, and similar wings B⁵ are arranged on the side walls and bottom of the bottom portion B² of the well.

The operation is as follows: When the well B is filled with a suitable quantity of mercury and the mercury-pump is set in action, by rotating the shaft F then the mercury is discharged in two oppositely-located continuous streams through the tips G' onto the depending metallic leaves or plates forming the electrodes H, and as the latter are stationary and the tips are bodily carried around it is evident that the tips pass the electrodes simultaneously and connect with the same by the continuous jets of mercury thrown on the inner faces of the electrodes. During this time the circuit is closed, as a continuous body of mercury extends from one electrode to the other. When the rapidly-moving streams of mercury approach the exit edges of the electrodes, just as the forward side of the mercury-stream enters the air-space between adjacent electrodes, owing to the great centrifugal force and the lack of sufficient cohesion of the stream of mercury, the latter immediately and with great suddenness glides past the edge of the leaf or blade and breaks up into numerous separate globules, which strike

the sides of the containing-body C and fall to the bottom, where they run together and flow back into the well B. By the use of the wings B⁴ B⁵ the downwardly-flowing globules of mercury are prevented from traveling around in the well, so that the mercury is prevented from revolving in the well. By having a continuous air-blast playing immediately behind each jet of mercury as the same leaves the tip G' an exceedingly sudden rupture of the circuit occurs practically simultaneously at two points. To vary the length of time that the circuit shall remain closed when the jets are rotating at a given speed, the block I, supporting the electrodes, is raised or lowered correspondingly by sliding the hanger-rods J up or down in the bushings K and then again fastening the same by the set-screws K', as previously described. By this arrangement a greater or less width of the V-shaped lower ends H' of the electrodes H is exposed to the passing jets. To vary the number of interruptions per second, either the revolutions per second of the jets are increased or diminished or a greater or less number of metal plates or leaves of suitable length and width are employed for the electrodes, or both the speed of the jets and the number of electrode-leaves may be varied within practical limits to produce the desired number of interruptions per second. Should for any reason the motive-power actuating the apparatus suddenly or slowly fail while the interrupter is in action, then the stream of mercury will rapidly diminish in size or instantly cease flowing, so as to produce a rapid rise of the resistance across the jets or cut off the current altogether on the cessation of the streams.

When connected in series with a suitable resistance or inductance, or both, and the pump is started and while the full potential exists between oppositely-lying leaves of a pair of electrodes, it is evident that as the mercury-jet grows thicker and thicker on the increase of the speed of the pump the resistance falls progressively to finally reach zero. Hence in either case, owing to the automatic variation of the resistance of the contact-points of the apparatus, a dangerous and undue rising of the current does not occur.

Having thus described my invention, I claim as new and desire to secure by Letters Patent—

1. An interrupter, comprising oppositely-arranged positive and negative electrodes, and a mercury-container having movement relative to the said electrodes and arranged to discharge streams of mercury upon the electrodes to form a periodical conductor between said electrodes, as set forth.

2. An interrupter, comprising positive and negative electrodes oppositely arranged, and a mercury-container having movement relative to the said electrodes to discharge connected streams of mercury onto the electrodes at the same time to form a periodical conductor be-

tween the electrodes and to move the streams simultaneously out of contact with said positive and negative electrodes to break the circuit at two points simultaneously, as set forth.

5 3. An interrupter, comprising oppositely-arranged positive and negative electrodes in the form of leaves each having its lower end gradually varying in width, a mercury-container arranged to discharge connected
10 streams of mercury onto the lower end of said leaves, and means for raising or lowering said electrodes to expose more or less of the surface of the leaves to the mercury, as set forth.

15 4. An interrupter, comprising fixed oppositely-arranged electrodes in the form of leaves, each having one lower corner cut off obliquely, and a mercury-container having opposite discharge-tips for discharging con-
20 nected streams of mercury onto the lower ends of the said leaves while the tips pass the leaves, and means for raising or lowering the said electrodes to vary the width of the leaves at the point of contact of the mercury with
25 the leaves, as set forth.

5. An interrupter, comprising fixed oppositely-arranged electrodes in the form of leaves, each having one lower corner cut off obliquely, a mercury-container having opposite discharge-tips for discharging connected
30 streams of mercury onto the lower ends of the said leaves while the tips pass the leaves, means for raising or lowering the said electrodes to vary the width of the leaves at the
35 point of contact of the mercury with the leaves, and air-blast devices moving with the said container and discharging air-blasts to blow out sparks at the mercury-streams, as set forth.

40 6. An interrupter, comprising electrodes, means for discharging connected streams of mercury upon the electrodes, and means for discharging blasts of air to dissipate the mercurial vapor formed as the mercury separates
45 from the electrodes, as set forth.

7. An interrupter, comprising oppositely-arranged positive and negative electrodes, a mercury-container having movement relative to the said electrodes to discharge streams
50 of mercury onto the electrodes to close the circuit and to move the streams out of contact with the electrodes to break the circuit, and air-blast devices, as set forth.

8. An interrupter having a mercury-pump comprising a revoluble cylinder, a spiral blade in the cylinder and revolving therewith, and pipes leading from the upper end of the cylinder, and a well in which the pump rotates, the well being provided with wings to
60 prevent the returning mercury from rotating with the pump, as set forth.

9. An interrupter having a revoluble mercury-pump, comprising a cylinder, a spiral blade in the cylinder, a head thereon and jet-
65 pipes leading from the head in opposite directions, as set forth.

10. An interrupter having a revoluble mercury-pump, comprising a cylinder, a spiral blade in the cylinder, a head thereon, jet-
70 pipes leading from the head in opposite directions, and lava tips on the said jet-pipes, as set forth.

11. An interrupter having a revoluble mercury-pump, comprising a cylinder, a spiral blade in the cylinder, a head thereon, jet-
75 pipes leading from the head in opposite directions, lava tips on the said jet-pipes, and air-blast devices in the form of trumpets, rotating with the said pump and having their discharge ends adjacent to the said tips, as
80 set forth.

12. An interrupter having a mercury-pump provided with lava tips for the discharge of the pump, as set forth.

13. An interrupter, comprising a casing
85 having a well for containing mercury, a revoluble pump in the said casing and having its inlet extending into the mercury, the pump having discharge-pipes extending in opposite directions, electrodes upon which the pipes
90 discharge, an insulating-block carrying the electrodes, hanger-rods supporting the block and connected with the electrodes, and means for adjustably supporting the said rods to raise or lower the block and electrodes to ad-
95 just the latter relative to the jet-pipes, as set forth.

14. An interrupter, comprising a casing having a well for containing mercury, a revoluble pump in the said casing and having its
100 inlet extending into the mercury, the pump having discharge-pipes extending in opposite directions, electrodes upon which the pipes discharge, an insulating-block carrying the electrodes, hanger-rods supporting the block
105 and connected with the electrodes, means for adjustably supporting the said rods to raise or lower the block and electrodes to adjust the latter relative to the jet-pipes, and wings in the said well to prevent the mercury from ro-
110 tating with the pump, as set forth.

15. An interrupter having a revoluble mercury-pump, and air-blast devices rotating with said pump, as set forth.

16. An interrupter, comprising a casing
115 having a well for containing mercury, a revoluble pump in the said casing and having jet-pipes extending downwardly and outwardly from the upper extremity of the pump and provided with tips of insulating material,
120 positive and negative electrodes contained in said casing, and against which the jets of mercury impinge periodically, and revoluble air-blast devices having their discharge ends adjacent to the said tips, as set forth.
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In testimony whereof I have signed my name to this specification in the presence of two subscribing witnesses.

RICHARD HOOPE CUNNINGHAM.

Witnesses:

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W. M. VAN ZANDT.